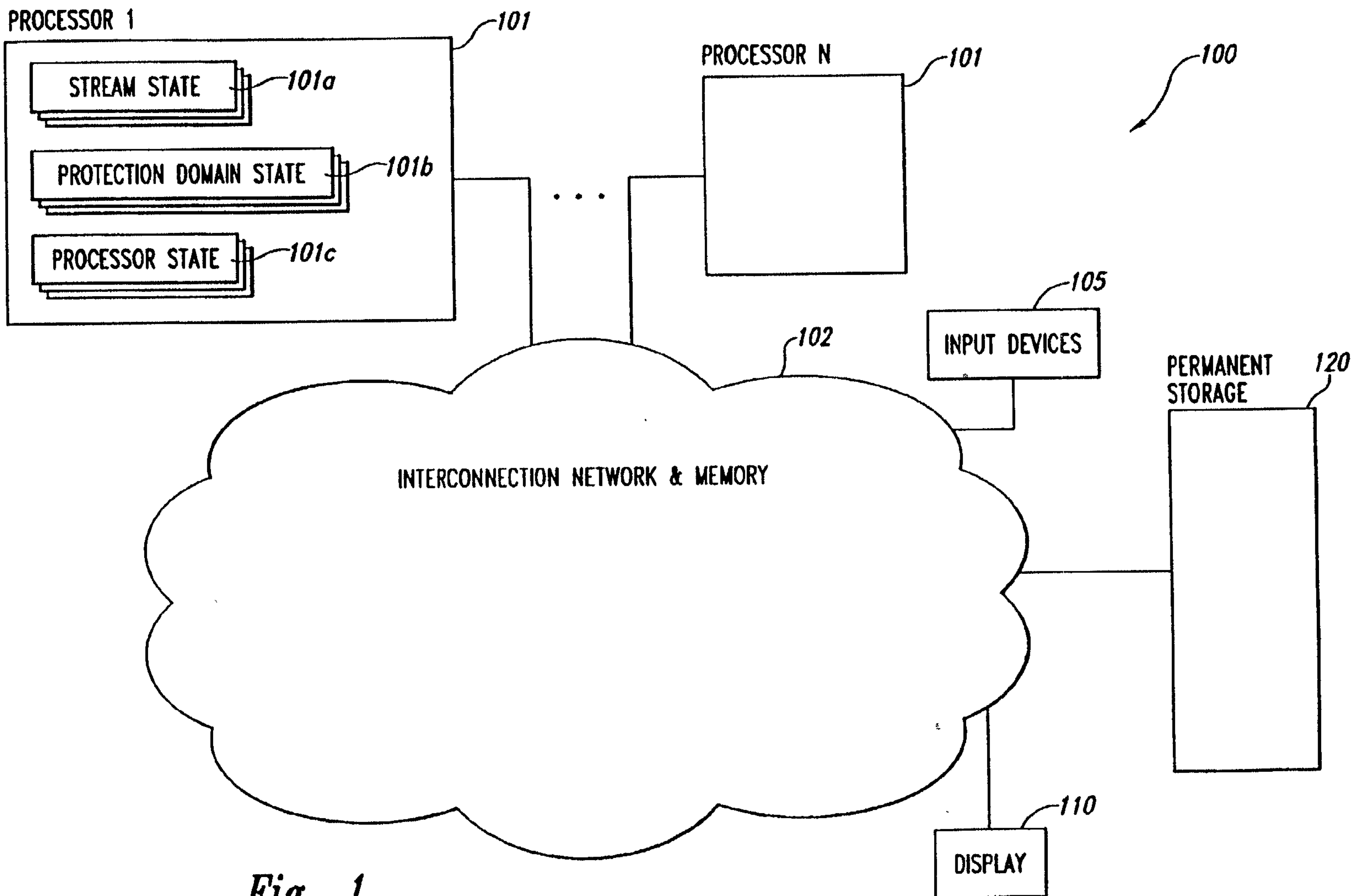
PROCESSOR 1
101
STREAM STATE
101a
PROTECTION DOMAIN STATE
101b
PROCESSOR STATE
101c
PROCESSOR N
101
100
105
INPUT DEVICES
102
INTERCONNECTION NETWORK & MEMORY
PERMANENT STORAGE
120
110
DISPLAY

Fig. 1

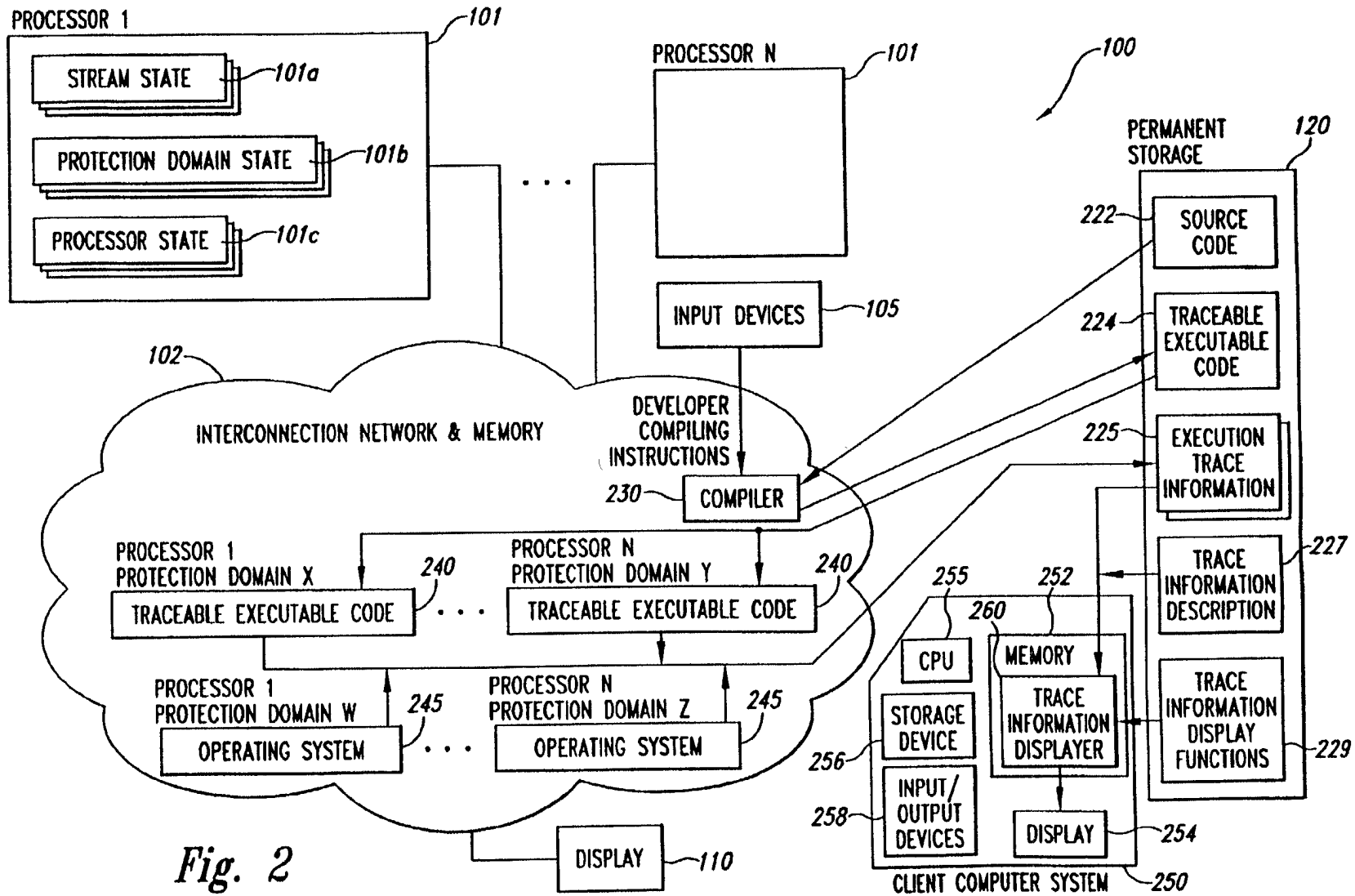
PROCESSOR 1
101
STREAM STATE
101a
PROTECTION DOMAIN STATE
101b
PROCESSOR STATE
101c
PROCESSOR N
101
100
PERMANENT STORAGE
120
222
SOURCE CODE
224
TRACEABLE EXECUTABLE CODE
225
EXECUTION TRACE INFORMATION
227
TRACE INFORMATION DESCRIPTION
229
TRACE INFORMATION DISPLAY FUNCTIONS
INPUT DEVICES
105
102
INTERCONNECTION NETWORK & MEMORY
DEVELOPER COMPILING INSTRUCTIONS
230
COMPILER
PROCESSOR 1 PROTECTION DOMAIN X
240
TRACEABLE EXECUTABLE CODE
PROCESSOR N PROTECTION DOMAIN Y
240
TRACEABLE EXECUTABLE CODE
PROCESSOR 1 PROTECTION DOMAIN W
245
OPERATING SYSTEM
PROCESSOR N PROTECTION DOMAIN Z
245
OPERATING SYSTEM
DISPLAY
110
255
CPU
252
MEMORY
260
TRACE INFORMATION DISPLAYER
STORAGE DEVICE
256
INPUT/ OUTPUT DEVICES
258
DISPLAY
254
CLIENT COMPUTER SYSTEM
250

Fig. 2

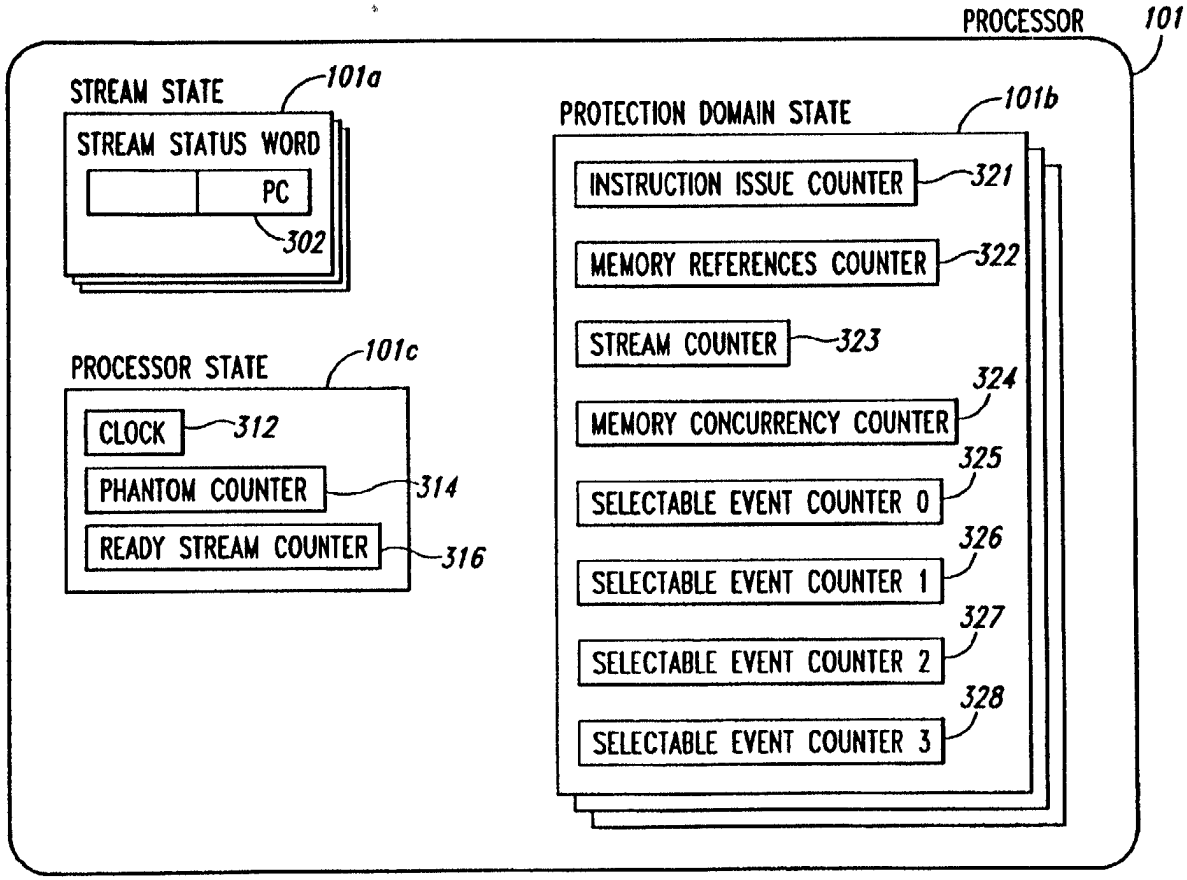

Fig. 3

Trace Information Description File

```
Trace Information Type Constants {      EVENT = 80000001
                                        DESCRIPTOR_OBJ = 80000002
                                        SWAP_OUT = 80000003          }

EventType Constants {       FUNCTION_ENTRY = 0
                            FUNCTION_EXIT = 1
                            USER_SPECIFIED = 2              }

event ProfileInfo {id = DESCRIPTOR_OBJ;
                   structure {
                        int             address;
                        int             pc;
                        EventType       kind : 8;
                        string          function_name;          } }

event Profile { id = EVENT;
          structure {
               int64 info               select ProfileInfo address ;
               int64 team_id    :16;
               int64 thread_id  :48;
               int64 current_time       COUNTS clock ;
               int64 issues_counter     COUNTS issues ;
               int64 mem_ops_counter    COUNTS memrefs ;
               int64 events0            COUNTS event0s ;
               int64 phantoms           COUNTS phantoms ;     }
          display_format =
               "Kind: %[info.kind]14s\n"
               "PC: 0x%[info.pc]x\n"
               "Team & Thread: %[team_id]d.%[thread_id]d\n"
               "Time#: %[current_time]d\n"
               "Phantoms#: %[phantoms]d\n";
          print_format =
               "Profile %[info.name]s %[info.kind]14s %[team_id]d.%[thread_id]d"
               "%[current_time]d:"
               "%[issues_counter]d %[mem_ops_counter]d %[events0]d %[phantoms]d\n" }
event SwapOut {
          id = SWAP_OUT;
          structure {
               int64 team ;
               int64 clock              COUNTS clock ;
               int64 memrefs            COUNTS memrefs ;
               int64 issues             COUNTS issues ;
               int64 phantoms           COUNTS phantoms ;
               int64 ready              COUNTS ready ;
               int64 event0s            COUNTS event0s ;
               int64 event1s            COUNTS event1s ;
               int64 event2s            COUNTS event2s ;
               int64 event3s            COUNTS event3s ; } }
```

Fig. 4A

Execution Trace Information File

80000002
A7
83
0
"FunctionX"
8000002
A8
9B
1
"FunctionX"
80000001
A7
C
3C7
0A32
0092
0027
0038
0028
80000001
A7
9
726
0076
0023
001D
0024
001C
80000003
9
0082
002B
0022
001C
0007
0024
0304
000E
00B3

Fig. 4B

Trace Information Display Functions File

```
define issues              field "issues_counter"
define phantoms            field "phantoms"

define issues_rate         rate (issues)
define available_rate      rate(issues+phantoms, 100000)

display available_rate
display if(available_rate > 0.0, issues_rate/available_rate)
```

Fig. 4C

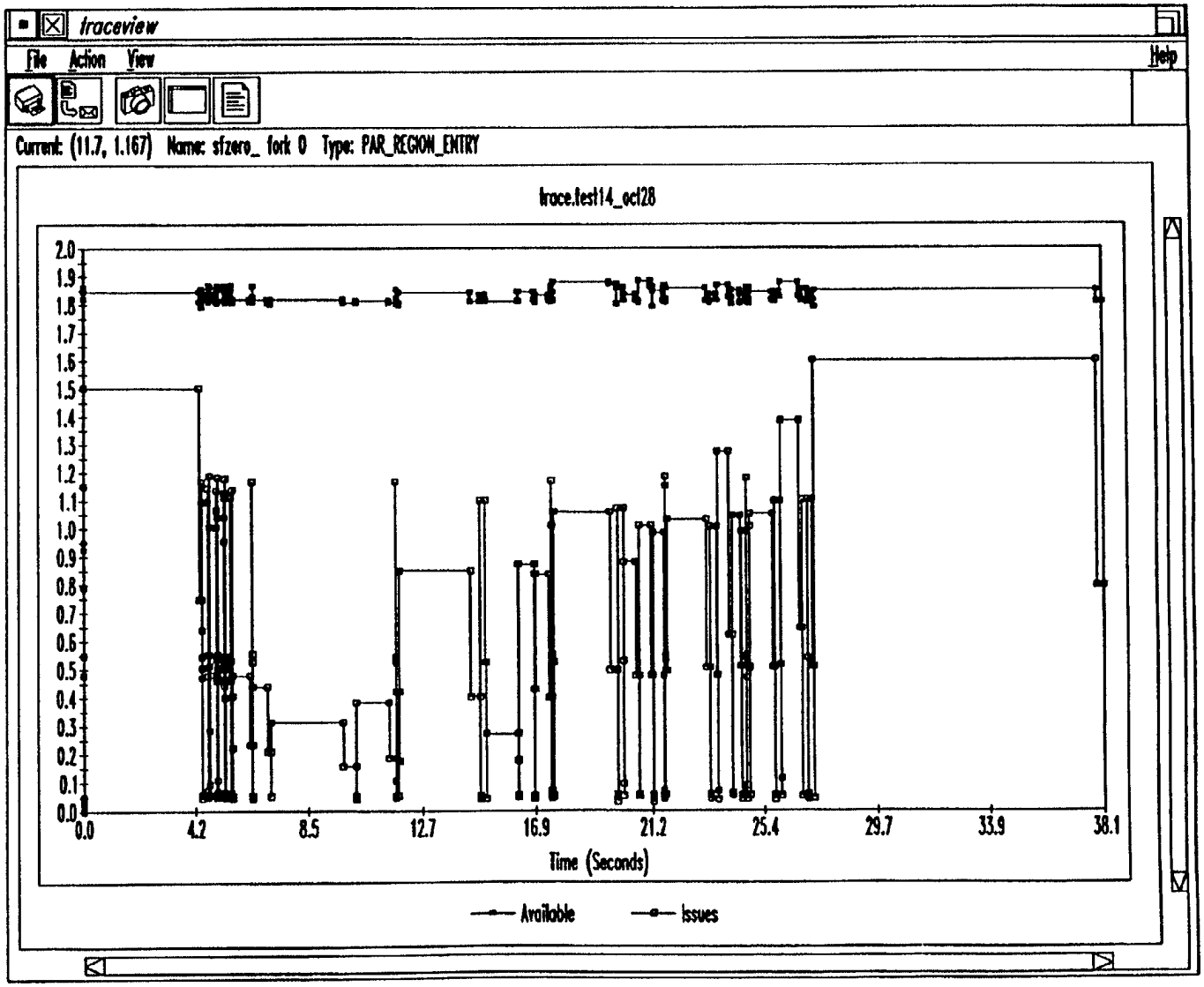
traceview
File Action View
Help
Current: (11.7, 1.167) Name: sfzero_ fork 0 Type: PAR_REGION_ENTRY
trace.test14_oct28
2.0
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.0
4.2
8.5
12.7
16.9
21.2
25.4
29.7
33.9
38.1
Time (Seconds)
Available
Issues

Fig. 5A

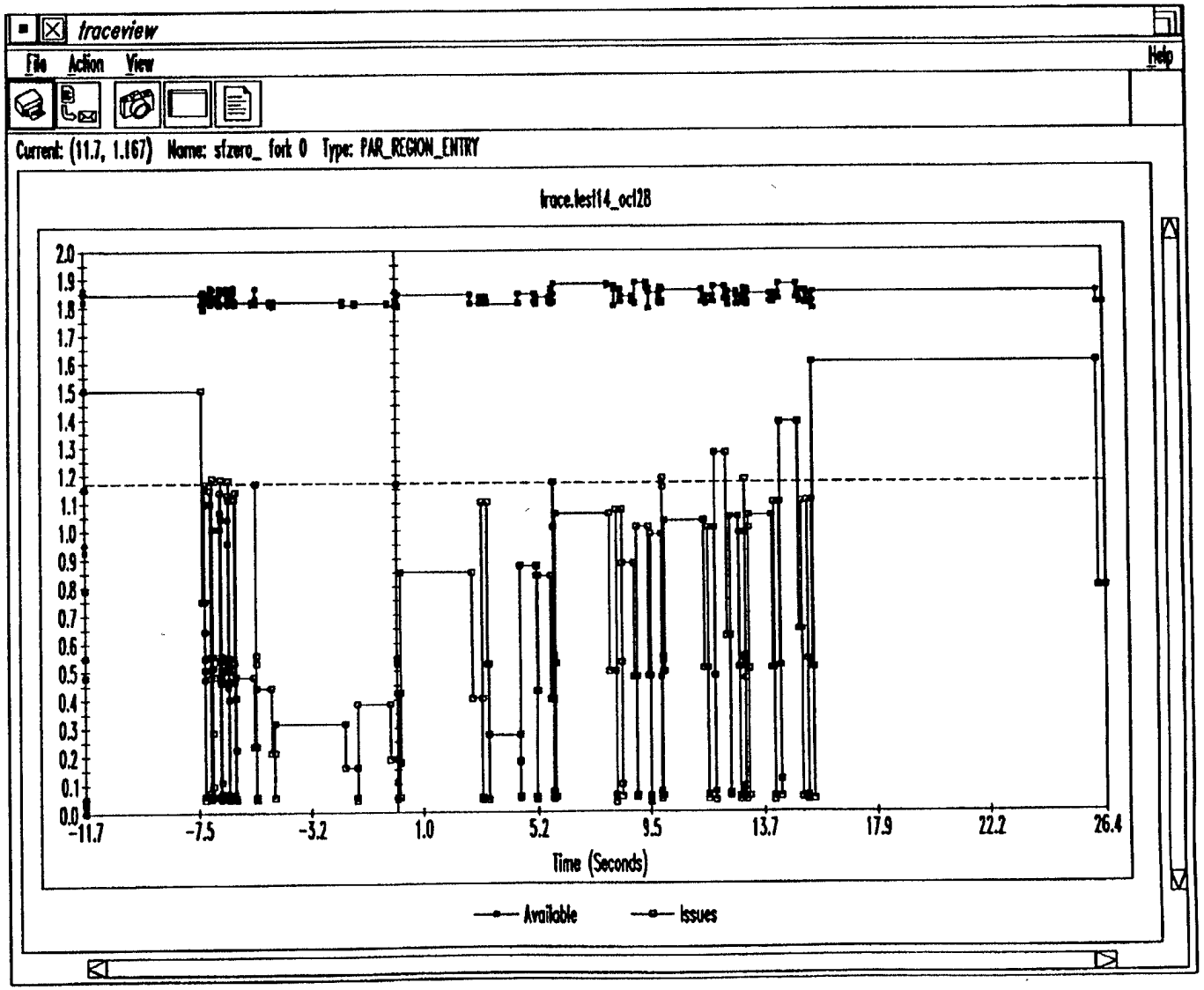
traceview
File Action View
Help
Current: (11.7, 1.167) Name: sfzero_ fork 0 Type: PAR_REGION_ENTRY
trace.test14_oct28
2.0
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-11.7
-7.5
-3.2
1.0
5.2
9.5
13.7
17.9
22.2
26.4
Time (Seconds)
Available
Issues

Fig. 5B

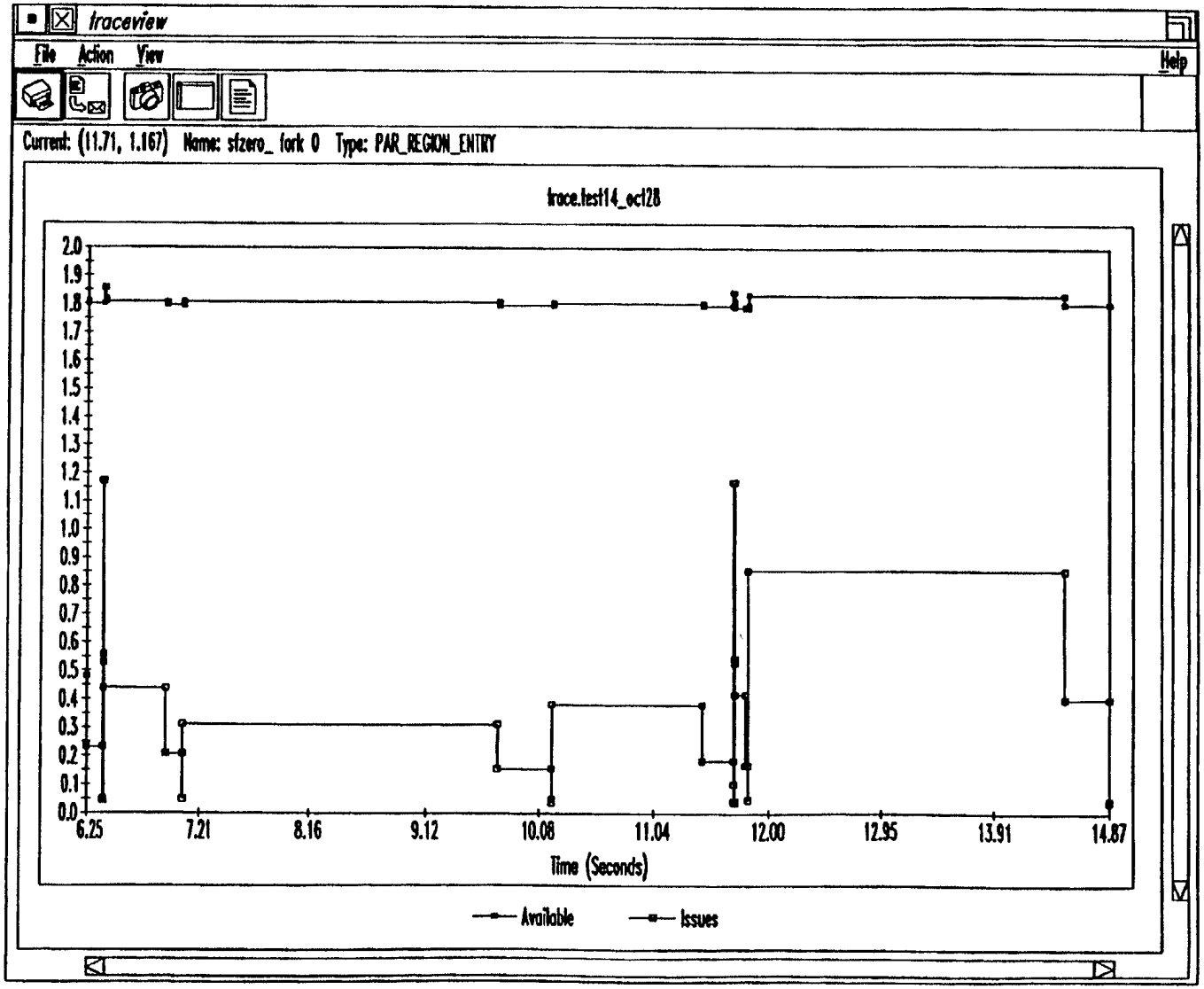

Fig. 5C

Point Detail

Display Filter

Event Table

Name	Kind	PC	Team	Chore	Time	Issues	Phantoms	MemOps	FLOPS	Streams	Parent
fmm_cfi_join 0	PAR_REGION_EXIT	0x455ef5	1	0.192	2,918,520,107	2,449,668,060	2,848,520,371	1,146,226,346	1,156,914,711		
fmm_cfi_join 0	PAR_REGION_EXIT	0x455ef5	0	0.1	2,984,796,075	2,462,064,507	2,955,106,871	1,155,948,529	1,168,395,041		
fmm_cfi	FUNCTION_EXIT	0x455f16	0	0.1	2,984,806,828	2,462,064,968	2,955,125,507	1,155,948,773	1,168,395,051		
sfzero	FUNCTION_ENTRY	0x454974	0	0.1	2,984,838,632	2,462,066,607	2,955,180,466	1,155,949,642	1,168,395,071		
sfzero_fork 0	PAR_REGION_ENTRY	0x4549ef	0	0.1	2,984,868,698	2,462,067,915	2,955,232,711	1,155,950,349	1,168,395,080	25	
sfzero_fork 0	PAR_REGION_ENTRY	0x4549ef	1	0.192	2,984,872,935	2,462,070,212	2,955,238,025	1,155,952,596	1,168,395,081	25	
sfzero_join 0	PAR_REGION_EXIT	0x454a3b	1	0.192	2,986,194,630	2,463,612,719	2,956,131,120	1,157,481,114	1,168,395,208		
sfzero_join 0	PAR_REGION_EXIT	0x454a3b	0	0.1	2,986,469,667	2,463,761,910	2,956,479,341	1,157,627,032	1,168,395,242		
sfzero	FUNCTION_EXIT	0x454a55	0	0.1	2,986,479,177	2,463,762,310	2,956,496,159	1,157,627,252	1,168,395,243		
evl_lrns_fork 0	PAR_REGION_ENTRY	0x455471	1	0.192	2,986,521,853	2,463,764,205	2,956,571,415	1,157,628,300	1,168,395,272	8	
evl_lrns_fork 0	PAR_REGION_ENTRY	0x455471	0	0.1	2,986,522,296	2,463,764,334	2,956,572,086	1,157,628,420	1,168,395,345	8	
evl_lrns_join 0	PAR_REGION_EXIT	0x455552	1	0.192	3,009,644,797	2,473,448,337	2,988,336,398	1,166,984,016	1,174,420,279		
evl_lrns_join 0	PAR_REGION_EXIT	0x455552	0	0.1	3,016,007,021	2,474,542,631	2,998,602,540	1,167,990,940	1,175,034,781		
fmm_cfi	FUNCTION_ENTRY	0x455c15	0	0.1	3,016,022,338	2,474,543,296	2,998,629,418	1,167,991,282	1,175,034,799		
fmm_cfi_fork 0	PAR_REGION_ENTRY	0x455d67	1	0.192	3,016,389,508	2,474,562,376	2,999,269,400	1,168,002,879	1,175,035,455	25	
fmm_cfi_fork 0	PAR_REGION_ENTRY	0x455d67	0	0.1	3,016,390,687	2,474,562,963	2,999,270,965	1,168,003,321	1,175,035,863	25	
fmm_cfi_join 0	PAR_REGION_EXIT	0x455ef5	1	0.192	3,699,655,302	3,056,488,270	3,667,787,021	1,609,896,203	1,610,124,134		
fmm_cfi_join 0	PAR_REGION_EXIT	0x455ef5	0	0.1	3,791,178,922	3,093,560,962	3,795,769,150	1,637,699,376	1,636,850,836		
fmm_cfi	FUNCTION_EXIT	0x455f16	0	0.1	3,791,189,974	3,093,561,430	3,795,788,703	1,637,699,632	1,636,850,846		
evl_lrns	FUNCTION_EXIT	0x455a4d	0	0.1	3,791,198,146	3,093,561,781	3,795,802,840	1,637,699,808	1,636,850,856		
evl_lrns	FUNCTION_ENTRY	0x454c18	0	0.1	3,791,208,397	3,093,562,228	3,795,820,961	1,637,700,046	1,636,850,873		
ifmm=5	USER_SPECIFIED	0x4555a4	0	0.1	3,791,214,304	3,093,562,470	3,795,831,375	1,637,700,171	1,636,850,874		
fmm_cfi	FUNCTION_ENTRY	0x455c15	0	0.1	3,791,264,736	3,093,565,235	3,795,919,310	1,637,701,665	1,636,850,887		
fmm_cfi_fork 0	PAR_REGION_ENTRY	0x455d67	1	0.192	3,791,624,087	3,093,583,887	3,796,547,625	1,637,713,041	1,636,851,542	25	
fmm_cfi_fork 0	PAR_REGION_ENTRY	0x455d67	0	0.1	3,791,624,525	3,093,584,162	3,796,548,149	1,637,713,223	1,636,851,802	25	
fmm_cfi_join 0	PAR_REGION_EXIT	0x455ef5	1	0.192	3,846,159,247	3,153,701,565	3,835,945,689	1,677,688,544	1,697,174,052		
fmm_cfi_join 0	PAR_REGION_EXIT	0x455ef5	0	0.1	3,851,843,684	3,156,693,141	3,843,237,131	1,679,644,011	1,700,098,655		
fmm_cfi	FUNCTION_EXIT	0x455f16	0	0.1	3,851,854,690	3,156,693,610	3,843,256,757	1,679,644,263	1,700,098,665		
evl_lrns_fork 0	PAR_REGION_ENTRY	0x4556cc	0	0.1	3,851,897,863	3,156,695,516	3,843,332,741	1,679,645,308	1,700,098,698	8	
evl_lrns_fork 0	PAR_REGION_ENTRY	0x4556cc	1	0.192	3,851,897,902	3,156,695,521	3,843,332,807	1,679,645,312	1,700,098,701	8	

Close | View Source... | Previous | Next | Help

Fig. 5D

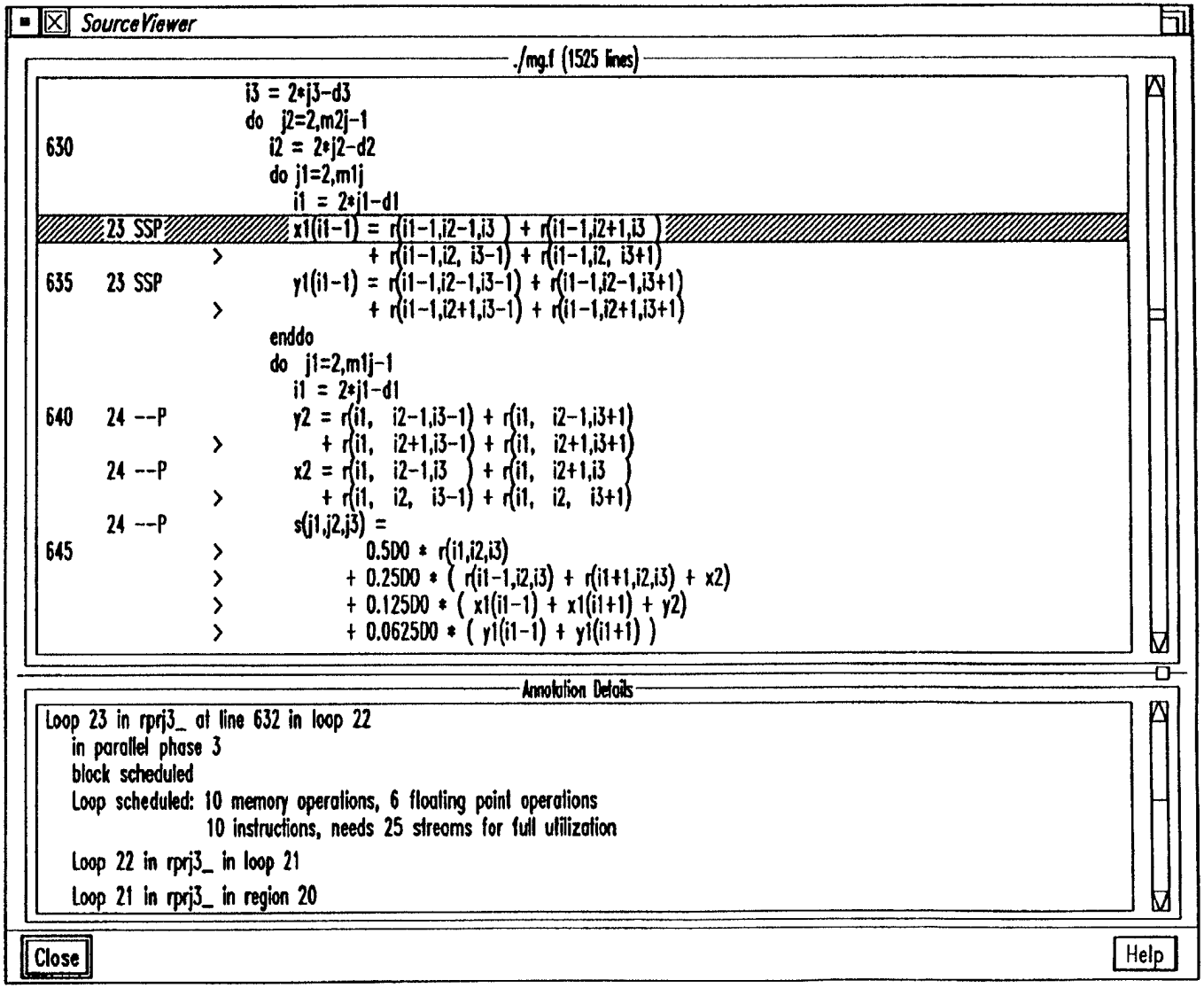
SourceViewer
./mg.f (1525 lines)
i3 = 2*j3-d3
do j2=2,m2j-1
630 i2 = 2*j2-d2
do j1=2,m1j
i1 = 2*j1-d1
23 SSP x1(i1-1) = r(i1-1,i2-1,i3) + r(i1-1,i2+1,i3)
> + r(i1-1,i2, i3-1) + r(i1-1,i2, i3+1)
635 23 SSP y1(i1-1) = r(i1-1,i2-1,i3-1) + r(i1-1,i2-1,i3+1)
> + r(i1-1,i2+1,i3-1) + r(i1-1,i2+1,i3+1)
enddo
do j1=2,m1j-1
i1 = 2*j1-d1
640 24 --P y2 = r(i1, i2-1,i3-1) + r(i1, i2-1,i3+1)
> + r(i1, i2+1,i3-1) + r(i1, i2+1,i3+1)
24 --P x2 = r(i1, i2-1,i3) + r(i1, i2+1,i3)
> + r(i1, i2, i3-1) + r(i1, i2, i3+1)
24 --P s(j1,j2,j3) =
645 > 0.5D0 * r(i1,i2,i3)
> + 0.25D0 * (r(i1-1,i2,i3) + r(i1+1,i2,i3) + x2)
> + 0.125D0 * (x1(i1-1) + x1(i1+1) + y2)
> + 0.062500 * (y1(i1-1) + y1(i1+1))
Annotation Details
Loop 23 in rprj3_ at line 632 in loop 22
in parallel phase 3
block scheduled
Loop scheduled: 10 memory operations, 6 floating point operations
10 instructions, needs 25 streams for full utilization
Loop 22 in rprj3_ in loop 21
Loop 21 in rprj3_ in region 20
Close
Help

Fig. 5E

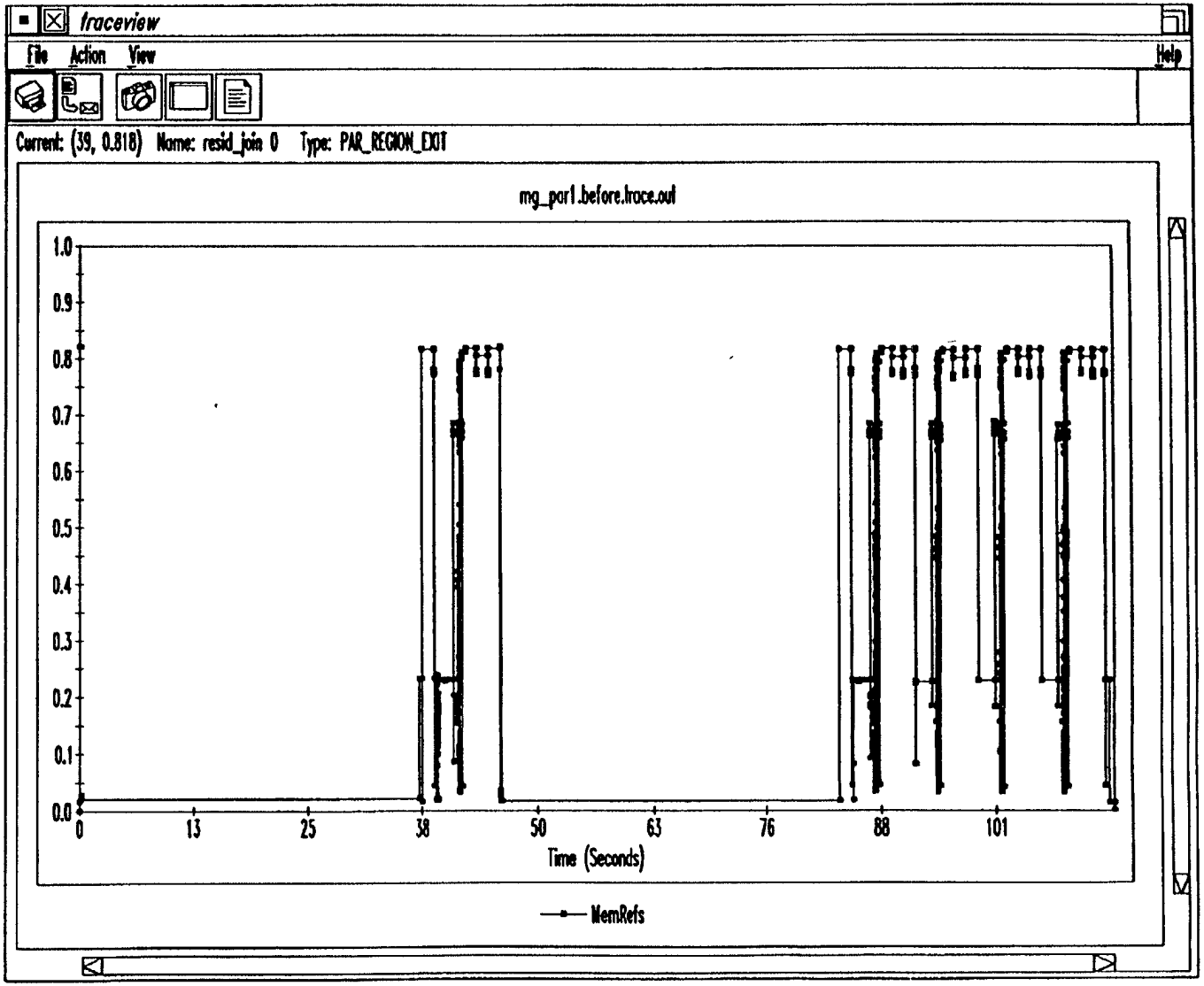

Fig. 5F

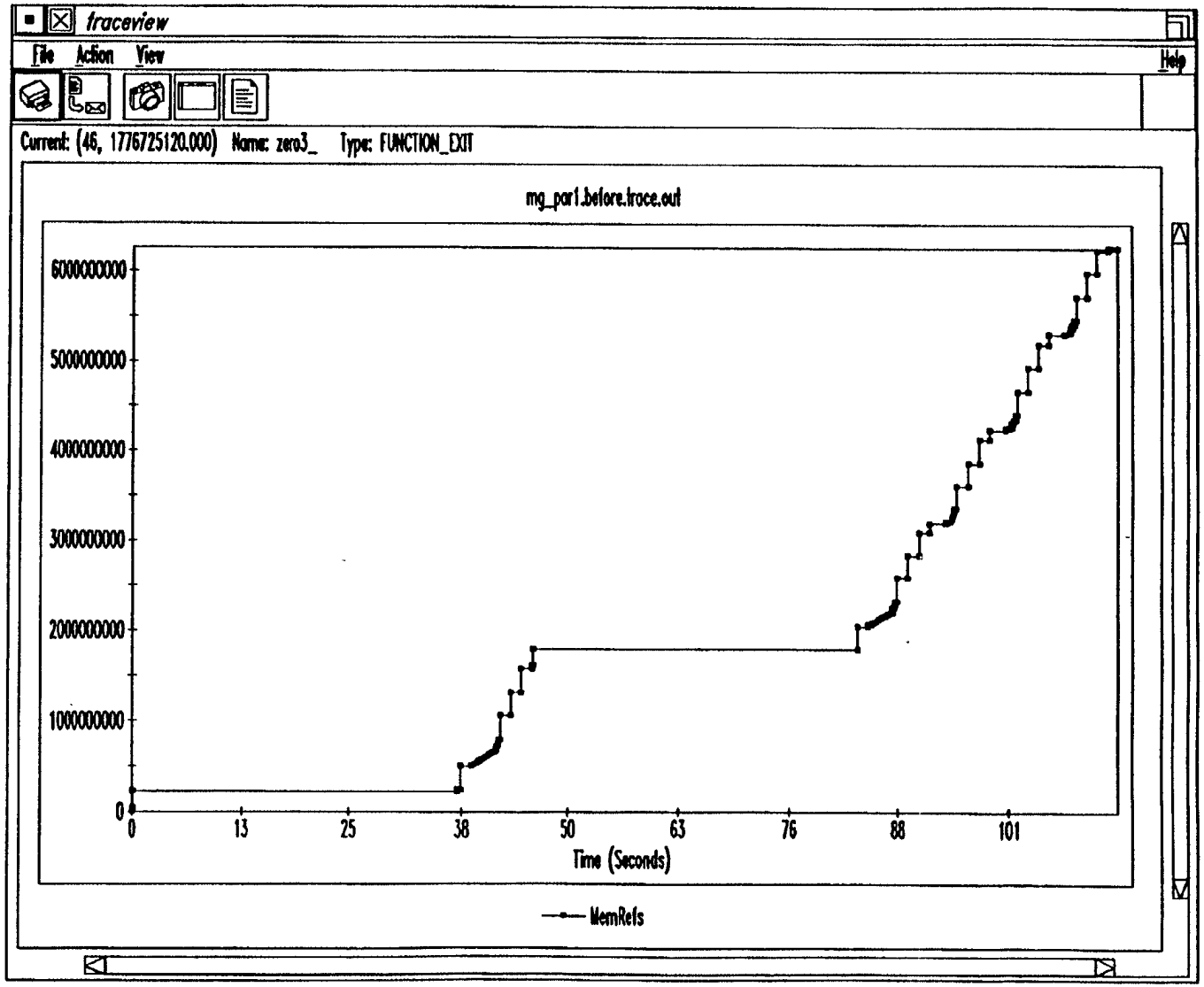
traceview
File Action View
Help
Current: (46, 17767251200.000) Name: zero3_ Type: FUNCTION_EXIT
mg_par1.before.trace.out
6000000000
5000000000
4000000000
3000000000
2000000000
1000000000
0
0
13
25
38
50
63
76
88
101
Time (Seconds)
MemRefs

Fig. 5G

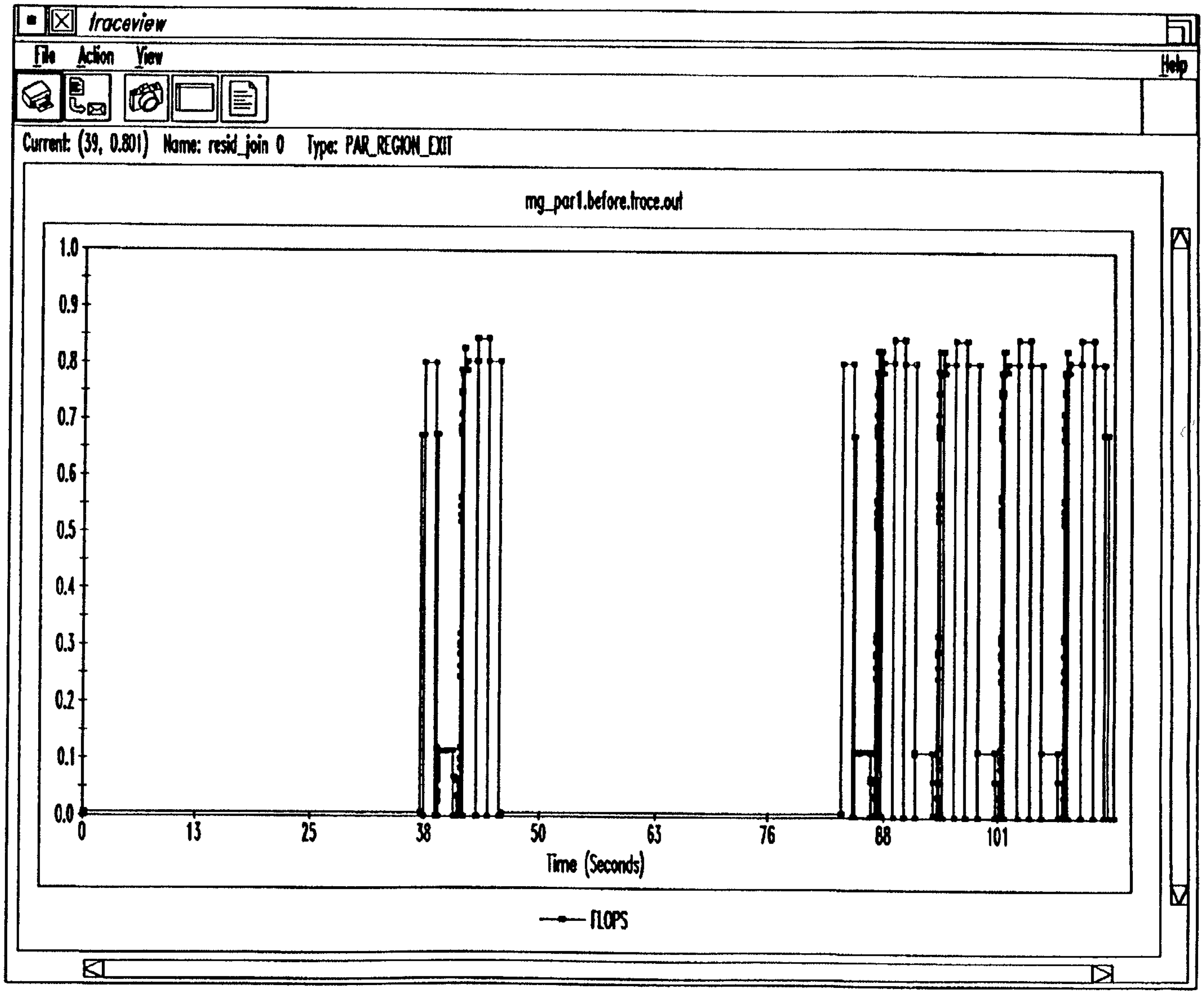
traceview
File
Action
View
Help
Current: (39, 0.801) Name: resid_join 0 Type: PAR_REGION_EXIT
mg_par1.before.trace.out
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
13
25
38
50
63
76
88
101
Time (Seconds)
FLOPS

Fig. 5H

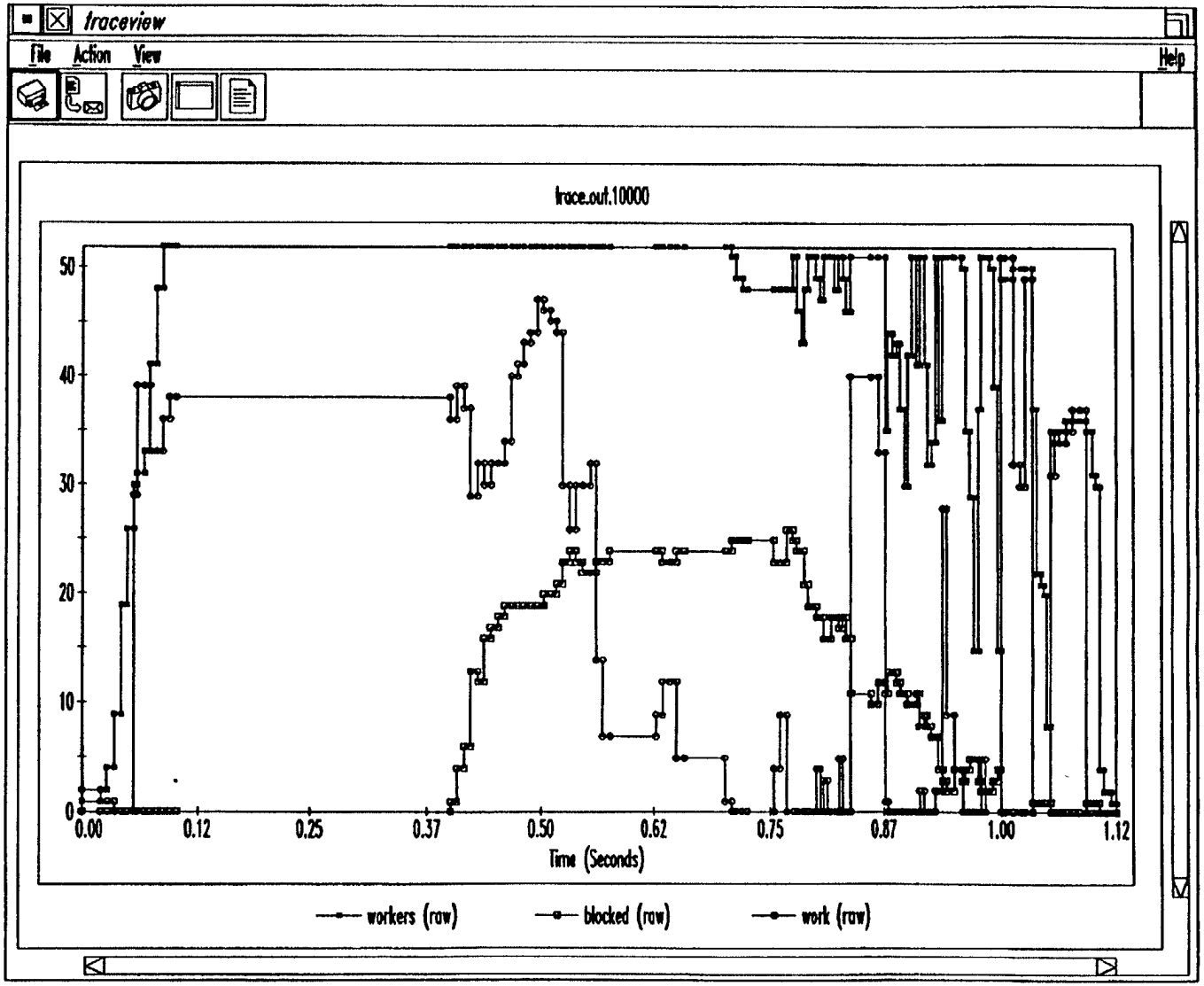

Fig. 5I

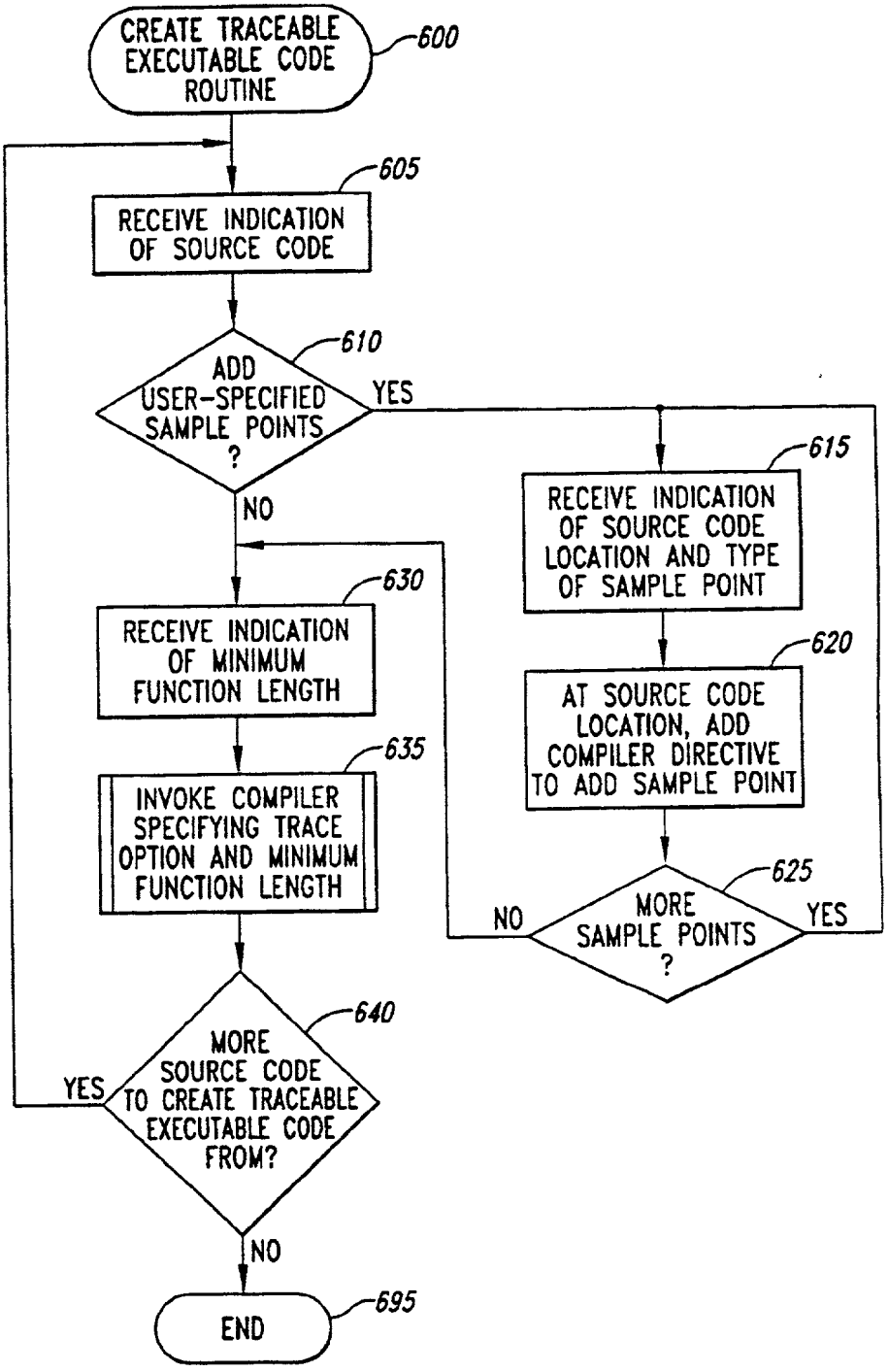
CREATE TRACEABLE EXECUTABLE CODE ROUTINE
600
RECEIVE INDICATION OF SOURCE CODE
605
ADD USER-SPECIFIED SAMPLE POINTS ?
610
YES
NO
RECEIVE INDICATION OF SOURCE CODE LOCATION AND TYPE OF SAMPLE POINT
615
AT SOURCE CODE LOCATION, ADD COMPILER DIRECTIVE TO ADD SAMPLE POINT
620
MORE SAMPLE POINTS ?
625
NO
YES
RECEIVE INDICATION OF MINIMUM FUNCTION LENGTH
630
INVOKE COMPILER SPECIFYING TRACE OPTION AND MINIMUM FUNCTION LENGTH
635
MORE SOURCE CODE TO CREATE TRACEABLE EXECUTABLE CODE FROM?
640
YES
NO
END
695

Fig. 6

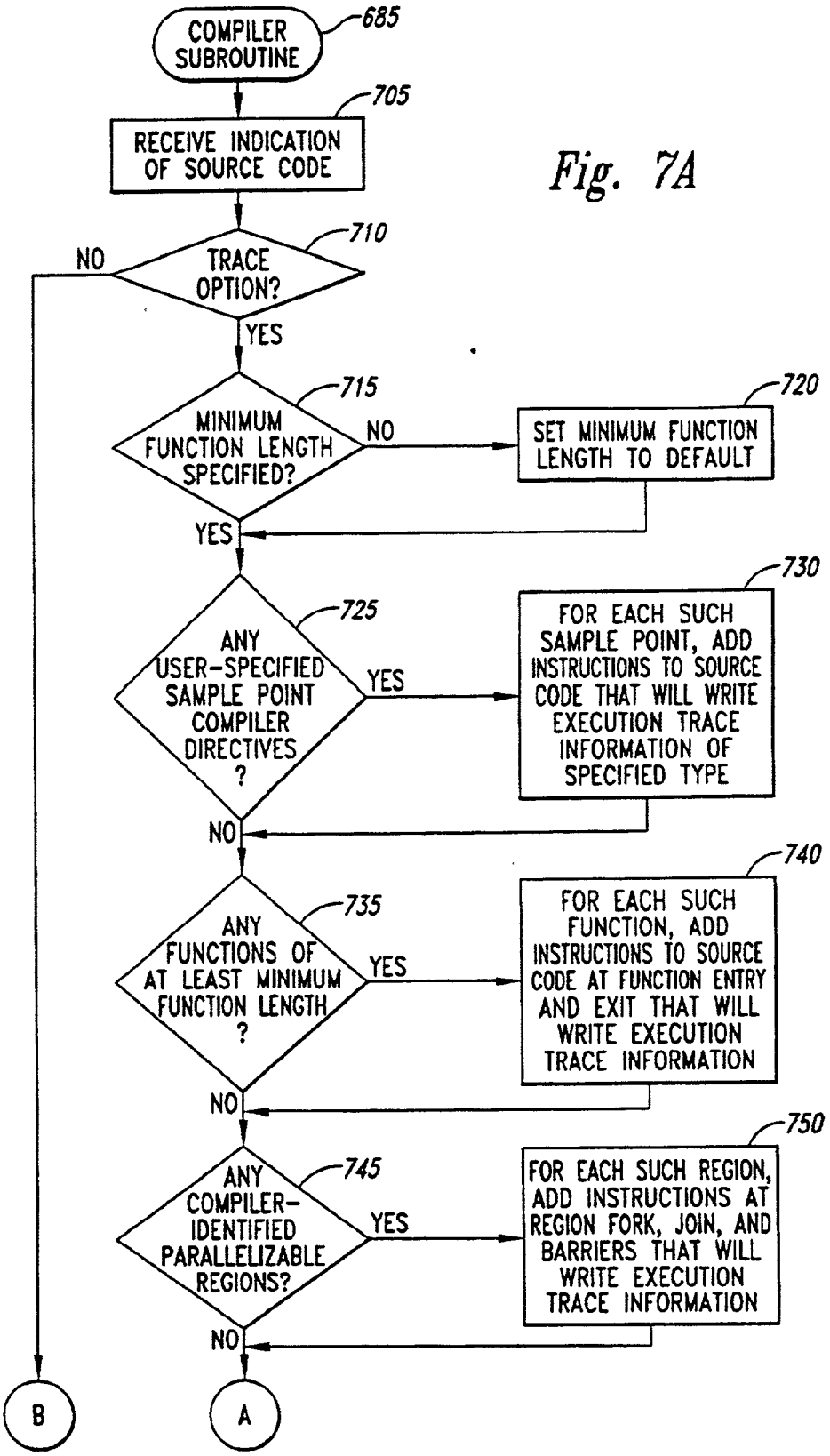
COMPILER SUBROUTINE
685
RECEIVE INDICATION OF SOURCE CODE
705
TRACE OPTION?
710
NO
YES
MINIMUM FUNCTION LENGTH SPECIFIED?
715
NO
SET MINIMUM FUNCTION LENGTH TO DEFAULT
720
YES
ANY USER-SPECIFIED SAMPLE POINT COMPILER DIRECTIVES ?
725
YES
FOR EACH SUCH SAMPLE POINT, ADD INSTRUCTIONS TO SOURCE CODE THAT WILL WRITE EXECUTION TRACE INFORMATION OF SPECIFIED TYPE
730
NO
ANY FUNCTIONS OF AT LEAST MINIMUM FUNCTION LENGTH ?
735
YES
FOR EACH SUCH FUNCTION, ADD INSTRUCTIONS TO SOURCE CODE AT FUNCTION ENTRY AND EXIT THAT WILL WRITE EXECUTION TRACE INFORMATION
740
NO
ANY COMPILER-IDENTIFIED PARALLELIZABLE REGIONS?
745
YES
FOR EACH SUCH REGION, ADD INSTRUCTIONS AT REGION FORK, JOIN, AND BARRIERS THAT WILL WRITE EXECUTION TRACE INFORMATION
750
NO
B
A

Fig. 7A

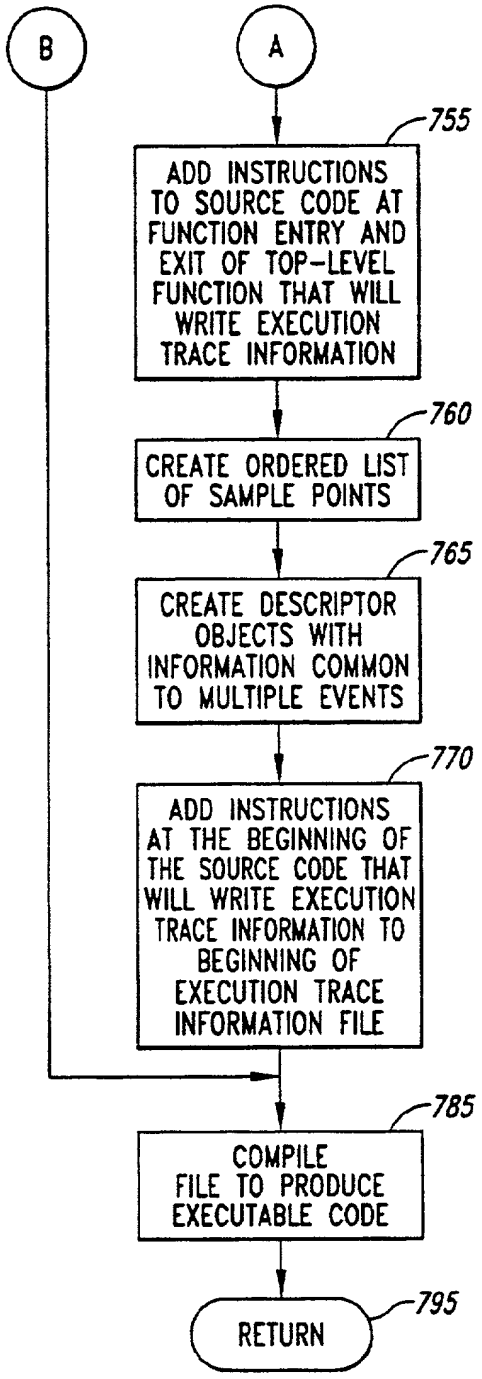
B
A
755
ADD INSTRUCTIONS TO SOURCE CODE AT FUNCTION ENTRY AND EXIT OF TOP-LEVEL FUNCTION THAT WILL WRITE EXECUTION TRACE INFORMATION
760
CREATE ORDERED LIST OF SAMPLE POINTS
765
CREATE DESCRIPTOR OBJECTS WITH INFORMATION COMMON TO MULTIPLE EVENTS
770
ADD INSTRUCTIONS AT THE BEGINNING OF THE SOURCE CODE THAT WILL WRITE EXECUTION TRACE INFORMATION TO BEGINNING OF EXECUTION TRACE INFORMATION FILE
785
COMPILE FILE TO PRODUCE EXECUTABLE CODE
795
RETURN

Fig. 7B

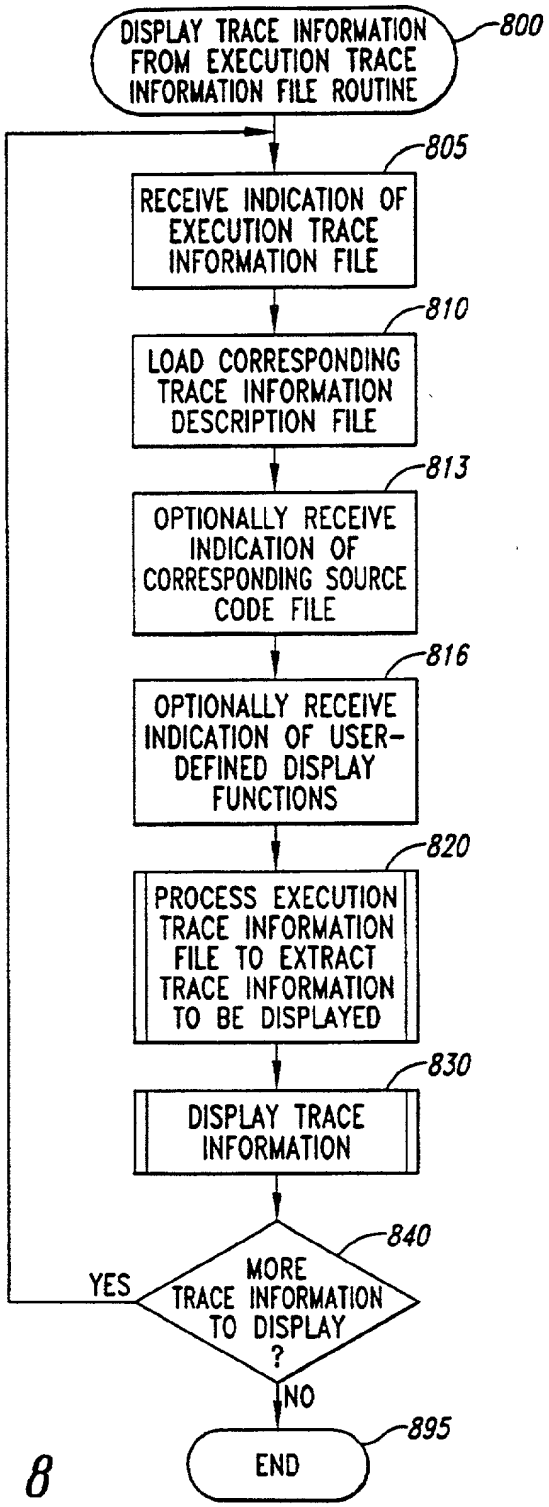
DISPLAY TRACE INFORMATION FROM EXECUTION TRACE INFORMATION FILE ROUTINE
800
RECEIVE INDICATION OF EXECUTION TRACE INFORMATION FILE
805
LOAD CORRESPONDING TRACE INFORMATION DESCRIPTION FILE
810
OPTIONALLY RECEIVE INDICATION OF CORRESPONDING SOURCE CODE FILE
813
OPTIONALLY RECEIVE INDICATION OF USER-DEFINED DISPLAY FUNCTIONS
816
PROCESS EXECUTION TRACE INFORMATION FILE TO EXTRACT TRACE INFORMATION TO BE DISPLAYED
820
DISPLAY TRACE INFORMATION
830
MORE TRACE INFORMATION TO DISPLAY ?
840
YES
NO
END
895

Fig. 8

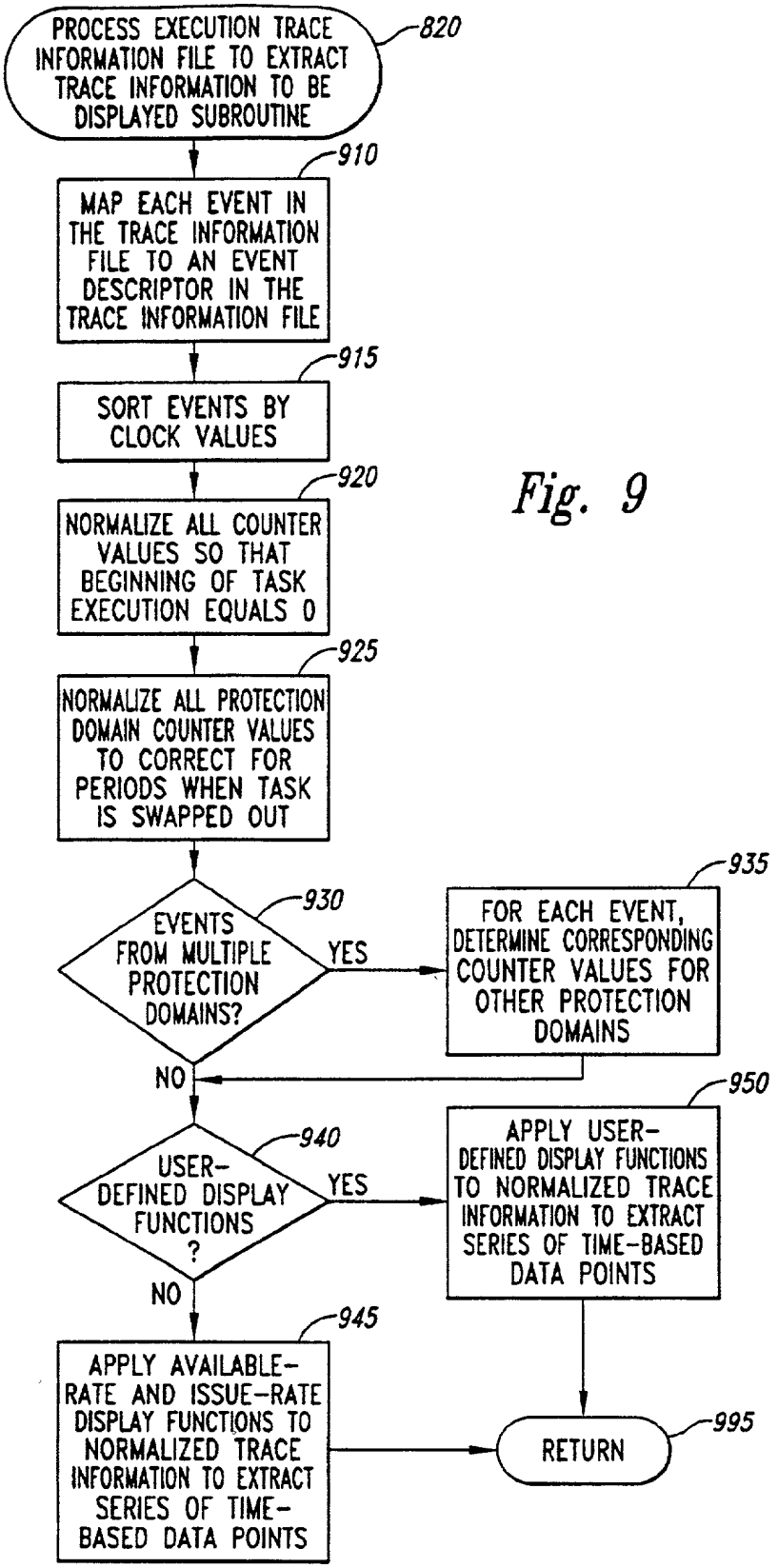
PROCESS EXECUTION TRACE INFORMATION FILE TO EXTRACT TRACE INFORMATION TO BE DISPLAYED SUBROUTINE
820
MAP EACH EVENT IN THE TRACE INFORMATION FILE TO AN EVENT DESCRIPTOR IN THE TRACE INFORMATION FILE
910
SORT EVENTS BY CLOCK VALUES
915
NORMALIZE ALL COUNTER VALUES SO THAT BEGINNING OF TASK EXECUTION EQUALS 0
920
NORMALIZE ALL PROTECTION DOMAIN COUNTER VALUES TO CORRECT FOR PERIODS WHEN TASK IS SWAPPED OUT
925
EVENTS FROM MULTIPLE PROTECTION DOMAINS?
930
YES
FOR EACH EVENT, DETERMINE CORRESPONDING COUNTER VALUES FOR OTHER PROTECTION DOMAINS
935
NO
USER-DEFINED DISPLAY FUNCTIONS ?
940
YES
APPLY USER-DEFINED DISPLAY FUNCTIONS TO NORMALIZED TRACE INFORMATION TO EXTRACT SERIES OF TIME-BASED DATA POINTS
950
NO
APPLY AVAILABLE-RATE AND ISSUE-RATE DISPLAY FUNCTIONS TO NORMALIZED TRACE INFORMATION TO EXTRACT SERIES OF TIME-BASED DATA POINTS
945
RETURN
995

Fig. 9

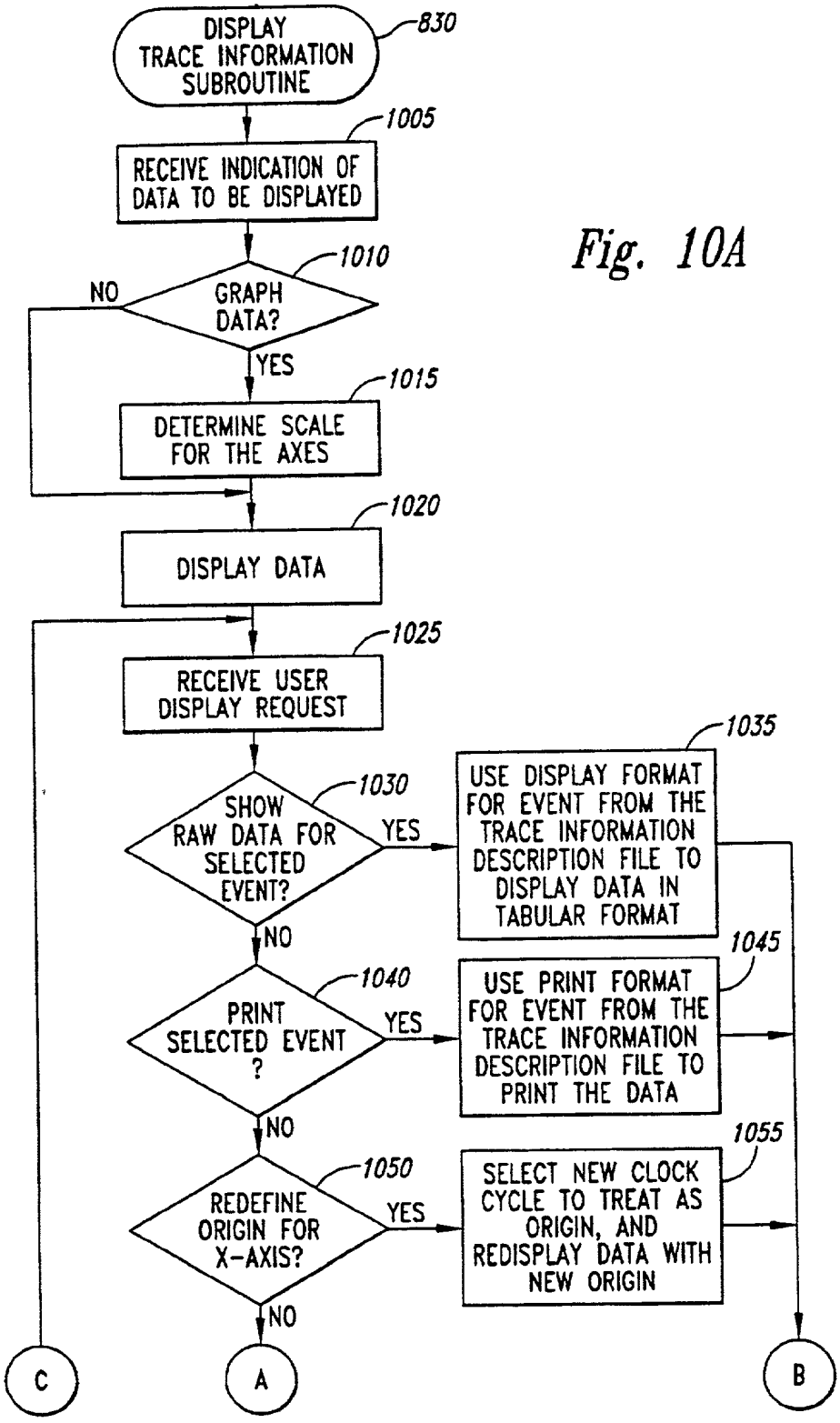
DISPLAY TRACE INFORMATION SUBROUTINE
830
RECEIVE INDICATION OF DATA TO BE DISPLAYED
1005
GRAPH DATA?
1010
NO
YES
DETERMINE SCALE FOR THE AXES
1015
DISPLAY DATA
1020
RECEIVE USER DISPLAY REQUEST
1025
SHOW RAW DATA FOR SELECTED EVENT?
1030
YES
USE DISPLAY FORMAT FOR EVENT FROM THE TRACE INFORMATION DESCRIPTION FILE TO DISPLAY DATA IN TABULAR FORMAT
1035
NO
PRINT SELECTED EVENT ?
1040
YES
USE PRINT FORMAT FOR EVENT FROM THE TRACE INFORMATION DESCRIPTION FILE TO PRINT THE DATA
1045
NO
REDEFINE ORIGIN FOR X-AXIS?
1050
YES
SELECT NEW CLOCK CYCLE TO TREAT AS ORIGIN, AND REDISPLAY DATA WITH NEW ORIGIN
1055
NO
C
A
B

Fig. 10A

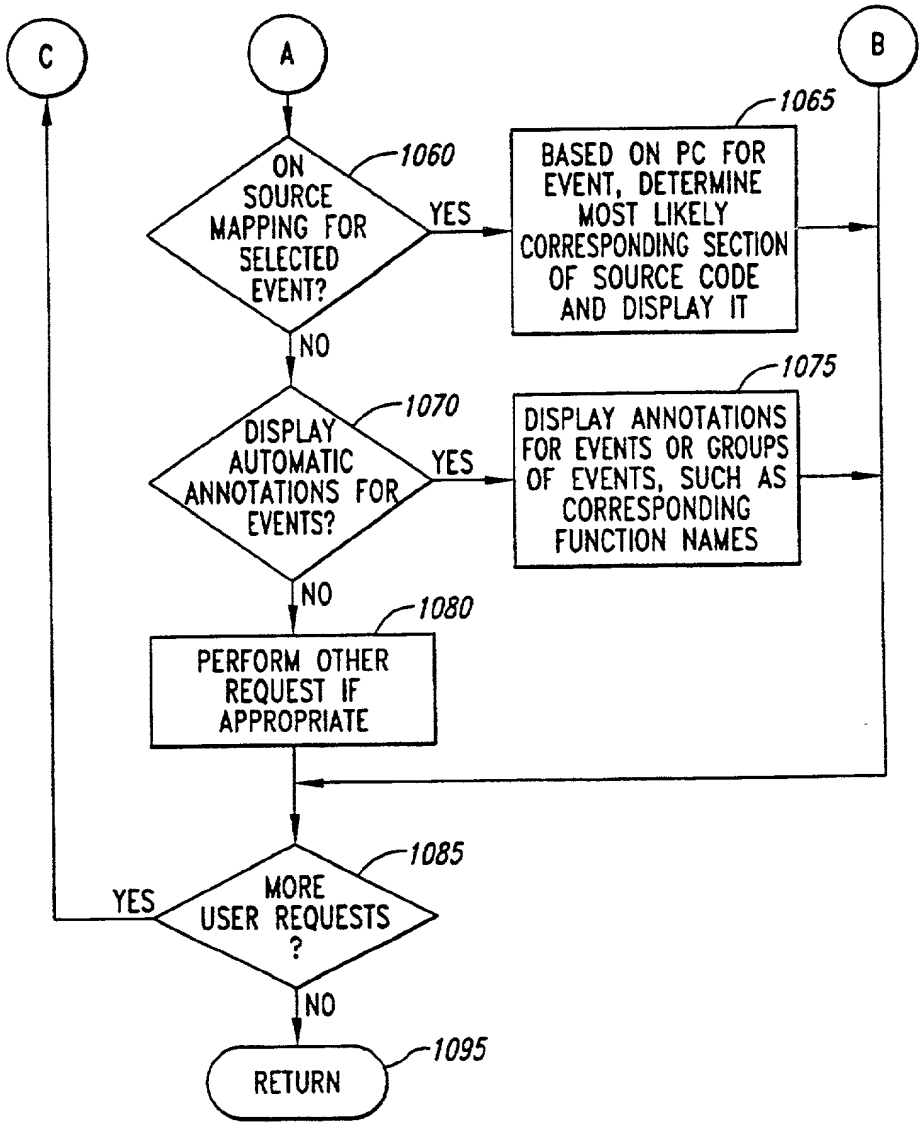
C
A
B
1060
ON SOURCE MAPPING FOR SELECTED EVENT?
YES
1065
BASED ON PC FOR EVENT, DETERMINE MOST LIKELY CORRESPONDING SECTION OF SOURCE CODE AND DISPLAY IT
NO
1070
DISPLAY AUTOMATIC ANNOTATIONS FOR EVENTS?
YES
1075
DISPLAY ANNOTATIONS FOR EVENTS OR GROUPS OF EVENTS, SUCH AS CORRESPONDING FUNCTION NAMES
NO
1080
PERFORM OTHER REQUEST IF APPROPRIATE
1085
MORE USER REQUESTS ?
YES
NO
1095
RETURN

Fig. 10B